MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2015/2016

EEE1046 – ELECTRONICS III

(All sections / Groups)

11 MARCH 2016
9:00am – 11:00am
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 6 pages with 4 Questions only.
2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please print all your answers in the Answer Booklet provided.

Question 1

(a) A non-inverting summing amplifier is shown in Figure Q1 (a), which has two input (V_1 and V_2), feedback resistor R_F, termination resistor R_a, input resistors R_1 and R_2 and load resistor R_L.

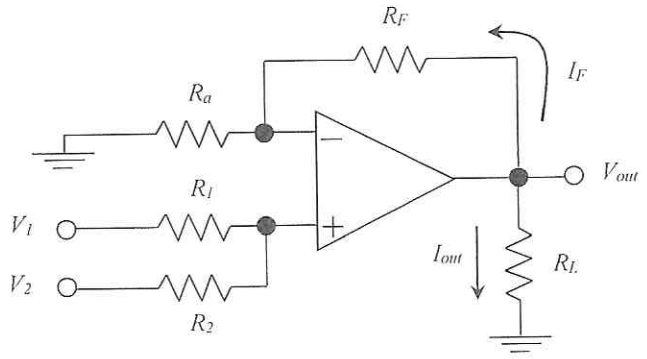

Figure Q1 (a)

(i) Draw the AC equivalent circuit to represent this amplifier.
[3 marks]

(ii) Derive the expression for V_{out} in terms of V_1 and V_2.
[6 marks]

(iii) Deduce the expression for I_F in terms of V_1 and V_2.
[3 marks]

(iv) Deduce the expression for I_{out} in terms of V_1 and V_2.
[2 marks]

(v) Suggest a usage of this amplifier, if $R_1 = R_2 = R_F = R$ and $R_a = 0.5R$. Explain briefly and justify your answer.
[3 marks]

(b) The instrumentation amplifier circuit shown in Figure Q1 (b) has $R_1 = R_2 = 4.7k\Omega$, $R_3 = 1k\Omega$ and R_{gain} is variable.

(i) Determine V_{o1} and V_{o2} in terms of R_1, R_{gain}, V_1 and V_2.
[4 marks]

(ii) Determine the value of Rgain required if the desired output is to be Vo= 5 (V_1-V_2).
[4 marks]

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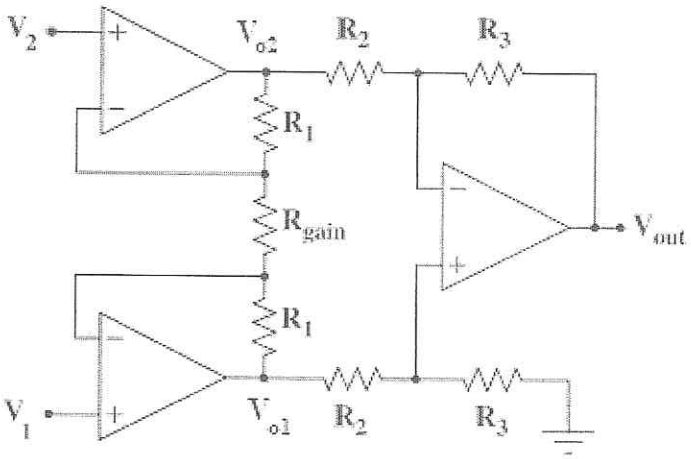

Figure Q1 (b)

Question 2

(a) The output voltage V_0 of an operational amplifier is 2.002V when $V_+ = 1005\mu V$ and $V_- = 995\mu V$. When $V_+ = 1010\mu V$ and $V_- = 1000\mu V$, V_0 is 2.00201V. Calculate the open loop gain A_{OL} and common-mode rejection ratio (in decibels) of the amplifier.

[10 marks]

(b) The ideal slew rate of the operational amplifier in Figure Q2 (b) is $0.5V/\mu s$.

(i) Is this an inverting or a non-inverting amplifier?

[1 mark]

(ii) Calculate the maximum frequency supported by the circuit for the case when $R_L = 5k\Omega$. Find out the maximum peak input voltage allowable.

[5 marks]

(iii) What are the new maximum frequency and maximum peak input voltage supported by the circuit if R_L is changed to $20k\Omega$?

[5 marks]

(iv) With the aid of a diagram, explain what will happen to the output of the circuit if the input exceeds the slew rate of $0.5V/\mu s$.

[4 marks]

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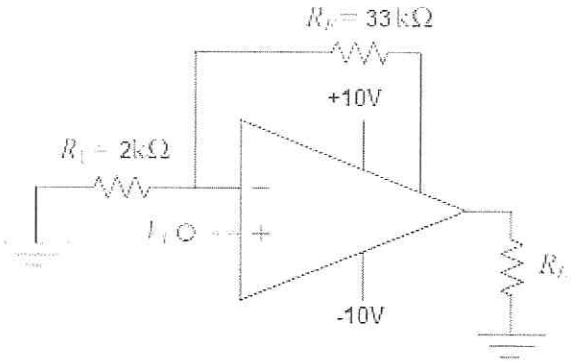

Figure Q2 (b)

Question 3

(a) The voltage regulator circuit shown in Figure Q3(a) has unregulated voltage V_i of 15V. The current gain (β) = 100 for the transistor. Assume 0.7V drop across any forward biased junction, calculate zener voltage (V_z) and zener current (Iz) when the regulated output voltage V_0 is 10V.

[12 marks]

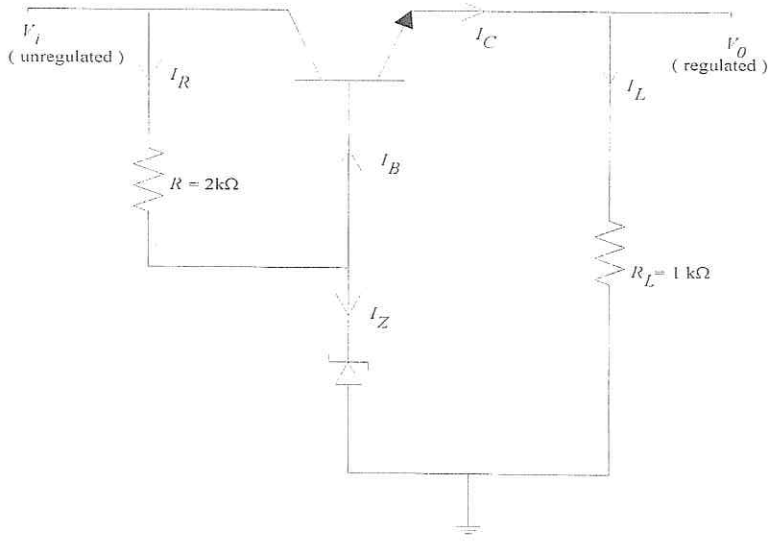

Figure Q3 (a)

Continued .....

(b) The basic phase shift oscillator is shown in Figure Q3 (b). Design a phase shift oscillator that can generate 5 kHz sine wave. Assume C = 0.1μF and gain of the amplifier = -29. You will need to specify all the value of the resistors in the circuit.

[6 marks]

(c) Propose a modification to the circuit in Figure Q3 (b) using both diodes and resistors in order to obtain the sinusoidal signal with 5V peak to peak. Assume diode forward bias voltage V_D = 0.7V. Show all calculation, assumption and the modified circuit (with all resistor values specified).

[7 marks]

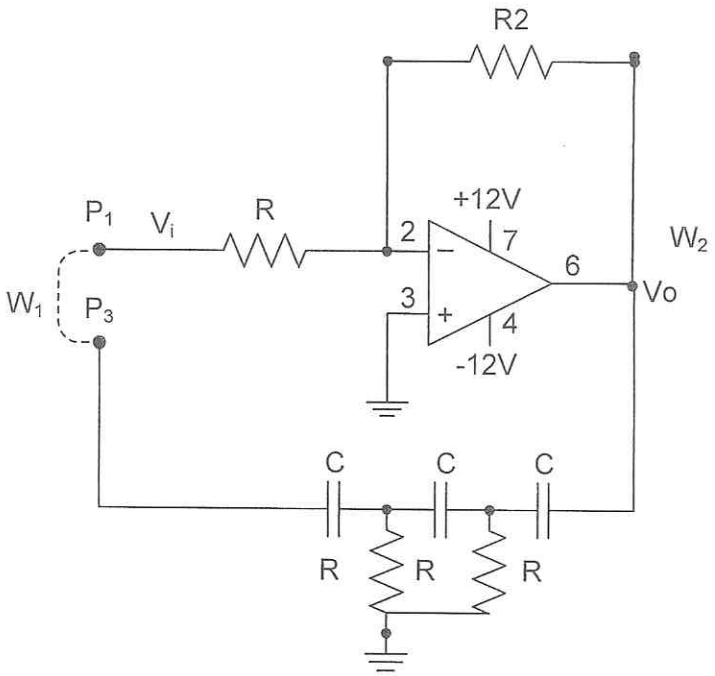

Figure Q3 (b)

Continued .....

Question 4

(a) As an electronics engineer, you are required to suppress the noise signal from the circuit. The noise signal has the frequency higher than 1 MHz. Suggest a suitable first order non-inverting active filter circuit configuration for that purpose. Also determine its transfer function.

[7 marks]

(b) Design a first order unity gain non-inverting low pass filter with f_c = 5 kHz and C = 33nF. Also show the circuit configuration.

[5 marks]

(c) Design a circuit that produces the following mathematical function. Use diodes in forward bias condition for this non-linear circuits.

$$V_0 = \sqrt{V_i}$$

[8 marks]

(d) The Schmitt trigger circuit is shown in Figure Q4 (d). The input voltage goes from +15V to -15V. The resistance values are R_1 = 10kΩ and R_2 = 100kΩ . Determine the positive and negative reference voltages and sketch the non-inverting output voltage (V+) waveform.

[5 marks]

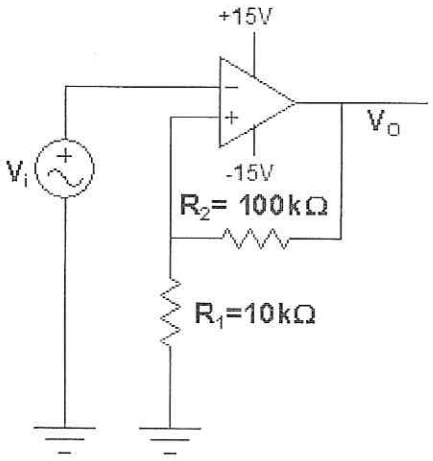

Figure Q4(d)

End of Paper